

PROCESS FOR INCREASING THE EFFICIENCY OF A COMPUTER
IN FINITE ELEMENT SIMULATIONS AND A COMPUTER FOR
PERFORMING THAT PROCESS

Abstract

5 The invention relates to a process for increasing the efficiency of a computer system in finite element simulations by efficient automatic construction of suitable basis functions for computing approximate solutions and one such computer system. In the process as claimed in the invention, a grid covering the simulation region is generated. B-splines defined thereon with supports, which intersect the
10 simulation region, are classified into inner and outer B-splines (5). Then, coupling coefficients for forming linear combinations of inner and outer B-splines are determined (6), and the parameters which determine the resulting basis functions, are stored and output.

List of designations and abbreviations

B_i	(weighted) extended B-splines (WEB-splines)
b_i	inner B-splines
b_j	outer B-splines
b_k	relevant B-splines
d	dimension of B-Splines
dist	distance function
dist(x)	distance of point x from boundary Γ
α_{ij}	coupling coefficients
f	perturbation function (right hand side of the differential equation)
FE	Finite Element
h	grid width, edge length
I	index set of the inner splines
$I(j)$	index set of the inner splines coupled to an outer spline
i	index of an inner spline
J	index set of the outer splines
$J(i)$	index set of the outer splines coupled to an inner spline
j	index of an outer spline
k	d -dimensional grid index
m	order of convergence
n	degree of B-splines
p_i	d -variate polynomial of degree n
Q_k	support of B-spline with index k
s	bound of the support portion in Ω
u	solution of the differential equation
v	flow velocity
$w(x)$	weight function

WEB	weighted extended B-spline
x_i	weight point in the simulation region
Z_k	grid cells
δ	parameter, the width of the strip in which the weight function rises
Γ	boundary of the simulation region
Ω	simulation region
1	definition of the simulation region
2	input and storage of boundary conditions
3	establishment of control parameters
4	determination of a grid and cell classification
5	classification of the B-splines
6	determination of the coupling coefficients
7	determination of a weight function
8	determination of weight points and scaling factors
9	assembling of a system of equations
10	solution of the system of equations
11	computation of an approximate solution
12	output of the approximate solution
20	control points
21	grid
22	outer grid cells
23	grid cells on the boundary
24	inner grid cells
25	stream lines
30	computer means

- 31 keyboard
- 32 read station
- 33 receiving station
- 34 output means
- 35 central control means
- 36 computer unit
- 37 storage means
- 38 data medium